Rediscovery of the Greater Glider *Petauroides volans* (Marsupialia: Petauroidea) in the Royal National Park, NSW.

Debbie Andrew[1], David Koffel[2], Glenn Harvey[3], Ken Griffiths[4] and Michael Fleming[1]

[1] Office of Environment and Heritage NSW, 43 Bridge St, Hurstville, NSW, 2220.

[2] Dame Mary Gilmore Rd, Oatley, NSW, 2223.

[3] Office of Environment and Heritage NSW, NPWG, Metro south-west region, Sutherland, NSW, 2232.

[4] Wallawa St, Heathcote, NSW, 2233.

ABSTRACT

At dusk on the 20 March 2012 bird watcher David Koffel observed a large gliding possum glide between trees at the southern end of Lady Carrington Drive in Royal National Park. David reported his observation to the Royal National Park Visitors Centre and a spotlighting excursion was organised to investigate the sighting. On the 30 March 2012 David Koffel, Debbie Andrew and Glen Harvey located the glider and confirmed its identity as a greater glider *Petauroides volans*. This was the first confirmed observation of a greater glider in Royal National Park since the wildfire of 1994, 18 years prior, which burnt more than 90% of Royal National Park and 50% of neighbouring Garawarra State Conservation Area. An account of the sightings and background to the observations are provided.

Key words: Garawarra State Conservation Area, greater glider, Hacking River catchment, *Petauroides volans*, post-fire response, Royal National Park, rediscovery, wildlife corridor.

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Introduction

The Royal National Park (NP) (15,092 hectares) and Garawarra State Conservation Area (SCA) (999 hectares) (formerly Garawarra State Recreation Area) are contiguous reserves that are situated on the southern shore of the Port Hacking estuary in the Hacking valley, approximately 25 kilometres south of Sydney. These reserves support a range of vegetation communities which include heathlands, shrublands, woodlands, open forests, tall open forests, rainforests, freshwater and estuarine wetlands (Office of Environment and Heritage Royal NP vegetation GIS layer, Keith & Tozer.).

In January 1994 a severe wildfire burnt more than 90% of the area of Royal NP and almost 50% of the area of Garawarra SCA (Andrew 2001). This included 927 hectares of the 1,082 hectares of the tall open blackbutt *Eucalyptus pilularis* forest (Shale Gully Forest, OEH Royal NP vegetation GIS layer, Keith and Tozer) that occurs within Royal NP and Garawarra SCA on the Narrabeen shales in the central and southern sections of the reserves which is the primary habitat of the greater glider *Petauroides volans* in the Hacking catchment. Approximately 900 hectares of blackbutt forest remained unburnt within Garawarra SCA and freehold lands of the upper Hacking catchment.

Prior to the 1994 wildfire the greater glider was regularly observed in small numbers in the southern part of Lady Carrington Drive in Royal NP (D. Andrew pers. ob.) but there was no estimate of the population size or detailed knowledge of the species distribution in the Hacking catchment. Maloney (2007) reported a single Australian Museum record from Helensburgh in 1909 and also a record by Clarke in 1945 in the same area, from Norm Robinson's records. Twenty greater gliders (14 females, 6 males) were collected from Lady Carrington Drive, Royal NP by Macquarie University between 1978 and 1980 (Maloney 2007).

This paper describes the rediscovery of the greater glider in Royal NP after an absence of sightings spanning an 18-year period.

Post-fire surveys

A spotlighting survey was undertaken by vehicle along Lady Carrington Drive shortly after the fire, in February 1994 by Debbie Andrew and Mathew Jones (NPWS Royal NP), located a single greater glider in a small patch of unburnt blackbutt tall open forest just south of Karani Brook. A second greater glider was seen by Mathew Jones on Bola Creek at the southern end of Lady Carrington Drive at the same time (OEH 2012, Atlas of NSW Wildlife, Bionet).

Following the January 1994 fire many large hollow-bearing trees, possibly up to 120, (B. Sullivan, NPWS Royal NP, pers. comm.) were felled along Lady Carrington Drive and throughout Royal NP for reasons of public safety. This would have reduced the number of hollows available for shelter for the greater glider and other hollow-dwelling fauna. Most of the tree canopy in the blackbutt tall open forests had been removed by the fire and so food resources for the folivorous greater glider (Fleay 1947; Henry 1995) would have been severely limited. Removal of the tree canopy also exposed gliders to greater predation pressure from the large owls, especially the powerful owl *Ninox strenua*.

During the summers of 1996 and 1997 comprehensive and extensive vertebrate fauna surveys were undertaken in the Royal and Heathcote National Parks and Garawarra SCA and parts of the upper Hacking catchment. The 1996 survey included spotlighting surveys for arboreal mammals across 47 km of survey transect encompassing 46.3 hours of spotlighting with a minimum of two observers (Andrew 2001). These surveys, two years following the 1994 fire, failed to locate any greater gliders and all possum species and sugar gliders were present only in very low numbers (Andrew 2001). Surveys for large forest owls and gliders in Royal NP undertaken by Dr Rod Kavanagh in 1996, 2001 and 2006 also failed to locate any greater gliders (R. Kavanagh pers. comm.). More recent surveys undertaken in Royal NP, Garawarra SCA and the upper Hacking catchment by the Office of Environment and Heritage in 2009 and 2010, particularly targeting the habitat of the greater glider, also failed to detect them (OEH 2011). It was thought that the greater glider may be locally extinct in the Hacking catchment, including the Royal NP and Garawarra SCA.

Rediscovery

On the 20 March 2012 bird watcher David Koffel observed at dusk, 1845 h DST (Daylight Saving Time), what he thought was a large gliding possum glide between trees at the southern end of Lady Carrington Drive. David reported his sighting to Glenn Harvey at the Royal NP Visitors Centre who recognised the potential significance of the sighting and passed on the observation to Debbie Andrew. Debbie, David and Glen organised to go out and search for the glider on the 30 March at 1900 h DST, commencing at the gate at the southern end of Lady Carrington Drive. The evening was still and clear after some earlier rain showers. The group spotlighted on foot utilising two 60 watt spotlights and walked along the Lady Carrington Drive (which is closed to vehicles) to Bola Creek picnic area, approximately 800 metres north of the gate, where three mountain possums *Trichosurus caninus*, including a mother and young, were observed. The group continued another 400 metres along Lady Carrington Drive, where a boobook owl *Ninox novaeseelandiae* was heard calling, before stopping at 2025 h DST and returning to the southern gate. At 2112 h DST, approximately 100 metres north of the gate a greater glider was observed in a tree on the eastern side of the road, immediately next to the track, sitting on a branch 3-5 metres above the ground. There was a very clear view and the glider was readily identified as a greater glider by Debbie Andrew. A photo was obtained with a small digital camera. This individual was a dusky grey on the back with a white chest and underbelly and had a light grey patch at the base of the tail on the dorsal surface. This was the first confirmed sighting of a greater glider in the Royal NP since the February 1994 sighting following the wildfire, 18 years ago. Locations were obtained for all sightings using a Garmin Oregon Global Positioning System for entry into the Office of Environment and Heritage (OEH) Atlas of NSW Wildlife database.

On the evening of 3 April Debbie, David, Mike Fleming, and wildlife photographer Ken Griffiths returned to the southern end of Lady Carrington Drive to see whether Ken could obtain a better photo of the greater glider. The night was still, warm and clear and we commenced spotlighting at 1846 h EST (Eastern Standard Time). At 1910 h EST a greater glider was observed about 170 metres north of the southern gate and about 50 metres east of the track. The greater glider appeared to be the same individual that was observed on the night of the 30 March as it was of similar colour and had the lighter patch at the base of the tail. A photo was obtained by Ken which

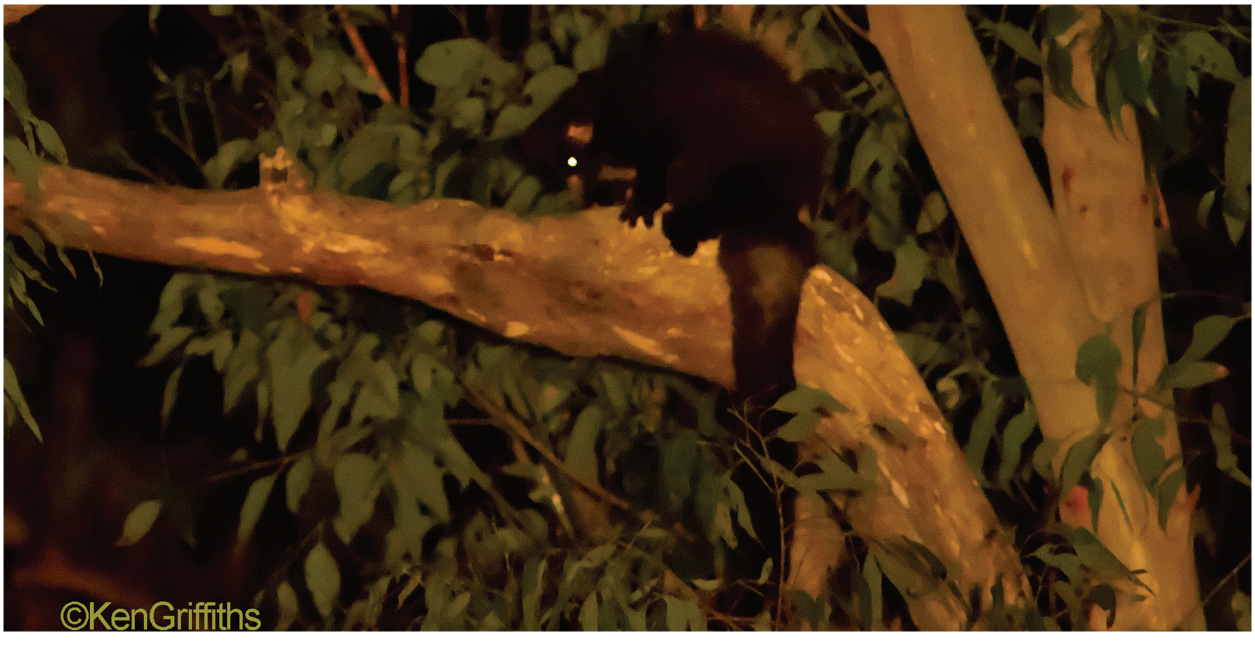

Figure 1: Greater glider *Petauroides volans* observed at Lady Carrington Drive, Royal NP on the 3rd April 2012. Photo, Ken Griffiths.

is sufficiently clear to identify the possum as a greater glider (Fig. 1). We continued spotlighting to Bola Creek picnic area and observed a sugar glider *Petaurus breviceps* and common ringtail possum *Pseudochierus peregrinus*. At 2017 h EST we returned to the southern gate, observed a boobook owl, but did not observe more greater gliders.

The source population of the greater glider remains unknown. It may be a descendent of a small number of individuals that survived the fire in Royal NP and remained undetected or perhaps came from a small population that remained undetected in the unburnt blackbutt forests of Garawarra SCA and the upper Hacking catchment. Alternatively it may have originated from a population much further south on the Illawarra Escarpment. The closest known recent records are about 12 kilometres to the south in the Cataract catchment west of Bulli (Fig. 2) (OEH 2012, Atlas of NSW Wildlife,

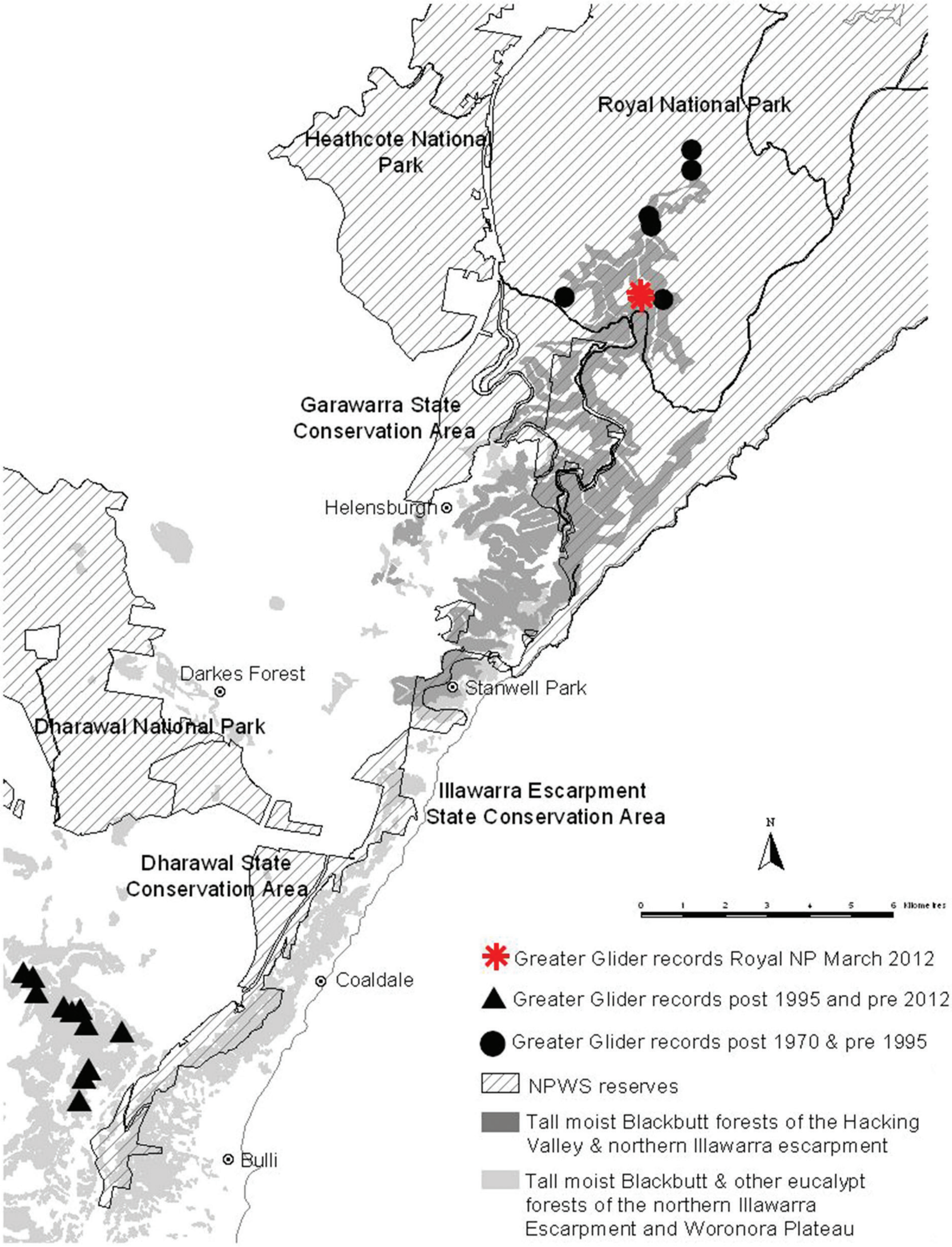
Royal National Park
Heathcote National Park
Garawarra State Conservation Area
Helensburgh
Darkes Forest
Stanwell Park
Dharawal National Park
Illawarra Escarpment State Conservation Area
Dharawal State Conservation Area
Coaldale
Bulli
N
0 1 2 3 4 5 6 Kilometres
Greater Glider records Royal NP March 2012
Greater Glider records post 1995 and pre 2012
Greater Glider records post 1970 & pre 1995
NPWS reserves
Tall moist Blackbutt forests of the Hacking Valley & northern Illawarra escarpment
Tall moist Blackbutt & other eucalypt forests of the northern Illawarra Escarpment and Woronora Plateau

Figure 2: The distribution of greater glider records *Petauroides volans* held in the OEH Atlas of NSW Wildlife database shown in respect to moist tall open forest communities of the upper Hacking valley and northern Illawarra escarpment and plateau. Vegetation mapping from Keith and Tozer (*unpublished OEH GIS layer*), NPWS (2002) and NPWS (2003a).

Bionet). The greater glider was reported to occur on the Illawarra Escarpment as far north as Coaldale by Robinson (1988). Another small population is known in the O'Hares Creek catchment in Dharawal National Park, about 15 kilometres to the west (OEH 2012, Atlas of NSW Wildlife, Bionet) and Robinson (1985) reports the species was found near Darkes Forest and streams south-west of Wedderburn (also in the O'Hares Creek catchment). In field studies undertaken by Maloney (2007) between 2003 and 2006 on the distribution of the greater glider in the Illawarra region he failed to detect any greater gliders in the Hacking catchment or on the northern Illawarra Escarpment north of Bulli. The lifespan of the greater glider is estimated to range from 10-15 years (Lindenmayer 1997) therefore the animal observed is unlikely to be a survivor of the 1994 fire in Royal NP.

Response of the greater glider to fire

Little has been reported on the response of greater glider populations to wildfire. Following the extensive and high-intensity wildfires of 1939 in the mountain ash *Eucalyptus regnans* forests of the Victorian central highlands Fleay (1947) reported in the Healesville area "Greater Gliders crawling weakly over charred ground" for weeks after the flames had died. He observed that for those "that survived in odd sheltered gullies died subsequently of starvation because leaves of their food trees, where not consumed (*by the fire*) were blasted and withered." Fleay (1947) then observed that by the autumn and winter months of 1943 and 1944 on visits to the same area "I was amazed to find the big gliders quite numerous again". He noted that "the deep valley of Badger Creek was not entirely devastated by fire, but from surviving stock in this valley, and perhaps others far away, it is logical to assume the increase must have come."

The impact of wildfire on the arboreal marsupials inhabiting the mountain ash forests of the Victorian Central Highlands was investigated by van der Ree and Loyn (2002) who compared the abundance of arboreal marsupials in 54 year old and 11 year old regrowth forest following the extensive high-intensity wildfires of 1939 and 1983. The greater glider was found to be much more abundant in 54 year old regrowth than in the11 year old regrowth forest. Their presence was thought to relate to forest structure, older regrowth having a greater amount of open space below the overstorey canopy and reduced density of stems. This study also considered the availability of hollow-bearing trees may have been a factor limiting populations of hollow-dependent marsupials such as the greater glider.

Lindenmayer *et al.* (2010) observed that the greater glider was absent from areas of mountain ash forests that had burnt in the 2009 fire where the forest canopy was burnt.

However the findings of studies undertaken on the impact of fire on the fauna of the mountain ash forests of the Central Highlands of Victoria are not directly applicable to the coastal blackbutt forests of NSW due to the differing responses of the tree species to fire and the consequent implications for forest structure. In high-intensity fires many individual mountain ash are killed and the forest regenerates from seed creating even-aged stands. Hollows required for denning by many arboreal marsupials are provided only by the remaining dead, standing, old growth trees or stags. It may take hundreds of years for the regenerating trees to grow to a size large enough to develop hollows (Lindenmayer *et al.* 1997; Lindenmayer *et al.* 2010). The number of available stags will depend on past fire and logging history (van der Ree and Loyn 2002). In contrast not all blackbutt trees are killed by fire and many re-sprout along trunks and branches from epicormic buds. A similar forest structure to that prior to the fire may be restored within a much shorter time span, potentially less than five years (Florence 1996).

In NSW, a small number of studies have reported observations on the response of arboreal marsupials to fire in low-altitude coastal eucalypt forests. In Nadgee Nature reserve on the far south coast of NSW a severe wildfire spread across much of the reserve in December 1972. Two months following the fire Fox (1978) observed common ringtail possums and greater gliders had survived in tall (> 25 m) woollybutt *Eucalyptus longifolia* forest on steep slopes and wet gullies which had not been severely burned. Seven months after the fire the greater gliders had spread out into regenerating mountain gum *Eucalyptus cypellocarpa,* stringybark *Eucalyptus muellerana* and rough-barked apple *Angophora floribunda.*

In Mumbulla and Tanja State forests near Bega on the NSW south coast which had been subject to logging Lunney (1987) found the greater glider was not present in logged coupes due to its dependence on large trees. Following fire unburnt south-east facing gullies provided critical refuges for possums and gliders.

In a study on the impact of fire on coastal forests, woodlands, shrublands and heathlands at Jervis Bay Lindenmayer *et al.* (2008) found greater gliders to be present in blackbutt *E.pilularis* / bangalay *Eucalyptus botryoides* forest. Following a fire in December 2003, survey sites were monitored for the three subsequent years and numbers of greater gliders were found to decline both on burnt and unburnt sites. The authors considered the decline could not be attributed to the fire but possibly to predation by large forest owls.

Studies and observations undertaken to date do not clearly elucidate the response of greater glider populations to severe wildfire. The time required for greater glider populations to be restored to pre-fire numbers in south-eastern Australian coastal eucalypt forests remains largely unknown.

Habitat Connectivity For The Greater Glider

Currently, blackbutt tall open forest extends in a relatively continuous corridor from the Royal NP and Garawarra SCA through the freehold lands of the upper Hacking valley to the tall open forests of the Illawarra Escarpment (including Illawarra Escarpment SCA) and the Metropolitan Water Catchments (Fig. 2) (Robinson 1977; NPWS 2003b). The corridor is broken in parts by local two lane roads, although at some sites such as at Stanwell Tops, the blackbutt forest canopy spans the road. The double track Illawarra Rail Line also bisects these tall forests, however, in several places the rail line passes through tunnels enabling a continuous forest corridor between Garawarra SCA and the forests of the upper Hacking catchment. The greater glider is reported to be able to glide up to 80 metres (R. Kavanagh pers. comm.) and so may be able to cross these smaller breaks (< 50 m) in the forest canopy. This forest corridor potentially provides an opportunity for the recolonisation of Garawarra SCA and Royal NP for a range of forest dwelling fauna, being especially important for species such as the greater glider that move through the tree canopy and rarely come to ground (Fleay 1947; Kerle 2001; Taylor and Goldingay 2009).

Prior to the establishment of the Royal NP in 1879 the area was primarily used for timber getting and even after the establishment of the 'National Park' these activities continued into the 1880's in the park (Fairley 1972; NSW NPWS 2000). Logging in the late 1800's and early 1900's may have reduced the availability of larger trees with large hollows on which the greater glider depends for shelter. Over time the number of large hollows is likely to increase as eucalypt trees continue to mature over the next 50-100 years (Mackowski 1984) and habitat quality for the greater glider should improve in the Hacking catchment, Royal NP and Garawarra SCA. Whether the population can return to earlier numbers may depend on the protection of the continuous blackbutt forest corridor through the Hacking catchment to the Illawarra Escarpment and Metropolitan Water Catchments, the protection of remaining old growth eucalypts which provide hollows for dens and the control of wildfires in the blackbutt tall open forests of the Hacking catchment which may have always had naturally long intervals (> 50 years) between major fire events.

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